



Standard Practice for Using the Fricke Reference-Standard Dosimetry System¹

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ε¹ NOTE—Equations 3 and 4 were corrected editorially in August 2005.

1. Scope

1.1 This practice covers the procedures for preparation, testing and using the acidic aqueous ferrous ammonium sulfate solution dosimetry system to measure absorbed dose to water when exposed to ionizing radiation. The system consists of a dosimeter and appropriate analytical instrumentation. The system will be referred to as the Fricke system. It is classified as a reference-standard dosimetry system (see **ISO/ASTM 51261**).

1.2 The practice describes the spectrophotometric analysis procedures for the Fricke dosimeter.

1.3 This practice applies only to gamma rays, x-rays (bremsstrahlung), and high-energy electrons.

1.4 This practice applies provided the following are satisfied:

1.4.1 The absorbed dose range shall be from 20 to 400 Gy **(1)**.²

1.4.2 The absorbed-dose rate does not exceed $10^6 \text{ Gy}\cdot\text{s}^{-1}$ **(2)**.

1.4.3 For radioisotope gamma-ray sources, the initial photon energy is greater than 0.6 MeV. For x-rays (bremsstrahlung), the initial energy of the electrons used to produce the photons is equal to or greater than 2 MeV. For electron beams, the initial electron energy is greater than 8 MeV (see **ICRU Reports 34** and **35**).

NOTE 1—The lower energy limits given are appropriate for a cylindrical dosimeter ampoule of 12-mm outside diameter. Corrections for dose gradients across an ampoule of that diameter or less are not required.

1.4.4 The irradiation temperature of the dosimeter should be within the range of 10 to 60°C.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*³

C 912 Practice for Designing a Process for Cleaning Technical Glasses

D 1193 Specification for Reagent Water

E 170 Terminology Relating to Radiation Measurements and Dosimetry

E 178 Practice for Dealing with Outlying Observations

E 275 Practice for Describing and Measuring Performance of Ultraviolet, Visible, and Near Infrared Spectrophotometers

E 666 Practice for Calculating Absorbed Dose from Gamma or X-Radiation

E 668 Practice for Application of Thermoluminescence-Dosimetry (TLD) Systems for Determining Absorbed Dose in Radiation-Hardness Testing of Electronic Devices

E 925 Practice for the Periodic Calibration of Narrow Band-Pass Spectrophotometers

E 958 Practice for Measuring Practical Spectral Bandwidth of Ultraviolet-Visible Spectrophotometers

2.2 *ISO/ASTM Standards:*

ISO/ASTM 51205 Method for Using the Ceric-Cerous Sulfate Dosimetry System

ISO/ASTM 51261 Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing

ISO/ASTM 51707 Estimating Uncertainties in Dosimetry for Radiation Processing

2.3 *International Commission on Radiation Units and Measurements (ICRU) Reports:*

ICRU Report 34 The Dosimetry of Pulsed Radiation⁴

ICRU Report 35 Radiation Dosimetry: Electrons with Initial Energies Between 1 and 50 MeV⁴

ICRU Report 60 Fundamental Quantities and Units for Ionizing Radiation⁴

ICRU Report 64 Dosimetry of High-Energy Photon Beams based on Standards of Absorbed Dose to Water⁴

¹ This practice is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.01 on Dosimetry for Radiation Processing.

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² The boldface numbers that appear in parentheses refer to a list of references at the end of this practice.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ Available from the International Commission on Radiation Units and Measurements (ICRU), 7910 Woodmont Ave., Suite 800, Bethesda, MD 20814.